

B. HPCN Will Satisfy the Greatest Array of
Personal/Mobile Service Needs, at Lowest Cost, With
a Highly Robust, Nationwide Intelligent Network

The HPCN represents an opportunity to merge the best of the state-of-the-art in radio technology with the impressive achievements in post-divestiture digital intelligent wireline networks into at least one, nationwide wireless system. The combination of network intelligence with low cost, high capacity radio communications will yield an extraordinarily robust and evolving menu of services unlike anything the wireless user community might have otherwise envisioned.

**1. Compared to Other Mobile Satellite
Proposals The HPCN Space Segment Can
Be Employed At Lowest Cost**

One measure of the cost effectiveness of the *hybrid personal communications network* concept is to compare its space segment costs to those of other contemporary satellite proposals currently pending before the Commission.²² CELSAT has analyzed the cost data for the systems proposed by Motorola (IRIDIUM), Loral/Qualcom (Globstar), TRW (Odyssey), Ellipsat (Ellipso I and II), and Constellation (Aries).²³ These costs are compared in **TABLE I**.

²² A large portion of the HPCN's cost, of course, will be related to the construction of the ground-cell systems. For purposes of this comparison, and in order to make an apples-to-apples comparison, neither these costs *nor the additional circuit capacity* that this investment would add have been included. In general, however, it would be reasonable to state that the cost of the ground-cell system would resemble the cost experience of the current cellular industry, adjusted to reflect the potential added capacity, scale economies and thus lower costs available through the one system operator HPCN concept.

²³ American Mobile Satellite Corporation (AMSC) has not been included because its system design is not directed at the same high quality voice/data market, such as indicated by a requirement for low power transmitters and low gain antennas. AMSC is perceived by CELSAT to serve a different market than that contemplated by HPCN.

PROPOSAL	EQUIVALENT VOICE CIRCUITS, U.S.	ANNUAL COST PER EQUIVALENT VOICE CIRCUIT (SATELLITE)	FREQUENCY EFFICIENCY (EQUIVALENT VOICE CIRCUITS PER MHz)
CELSTAR	54,000	\$640	1465
A	7,600	\$7,960	152
B	6,960	\$12,080	275
C	4,600	\$5,380	139
D	864	\$19,411	25
E	200	\$60,000	12

TABLE I

HPCN's relative capacity (CELSTAR) is compared to those in TABLE I above.²⁴ The HPCN is shown to have 6.6 times more space-only capacity than the next closest system (Globstar). This capacity, alone, will accommodate an order of magnitude more subscribers.

Of course, to serve the broad cross section of users at the penetration levels anticipated for HPCN, the price to the end users must not only be reasonable, but at or lower than the price for alternative wireless services. CELSAT has computed that the amortized capital cost of each VG circuit over the life of one HPCN

²⁴ For this comparison CELSAT assumed an HPCN satellite system operating at the proposed S-Band, with about 4% of the space-segment capacity apportioned for ground-cell use, leaving about 54,000 equivalent VG circuits of space capacity. The other systems, A - E, of course only operate in the space mode. Therefore all potential U.S. space capacity has been included.

satellite will come to less than one cent/VG channel/minute²⁵ -- low enough to ensure comparably low end user rates. (See FIGURE 3.) This, in turn, is supported by HPCN's much lower deployment cost. To achieve the equivalent of full time, total coverage over CONUS. CELSAT would have to launch only one of its two proposed geostationary satellites. The cost to construct and launch one such HPCN satellite compared to the comparable costs for the multiple satellites required by the other systems to attain full time U.S. coverage is compared in FIGURE 4. HPCN is clearly shown as the most cost effective way to offer mobile satellite service.

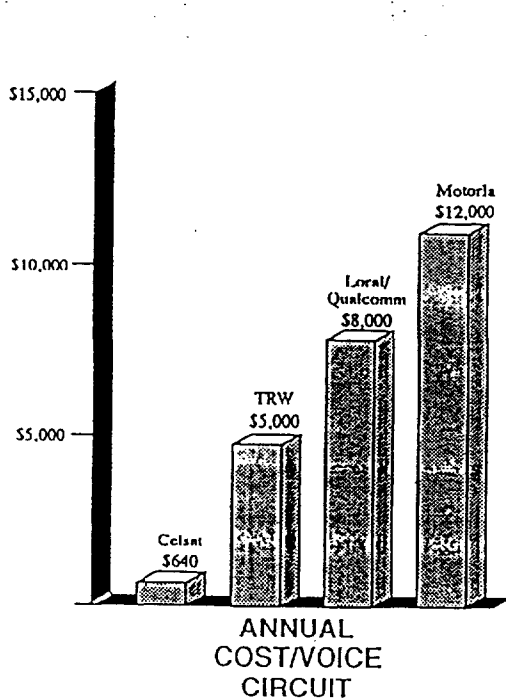


FIGURE 3

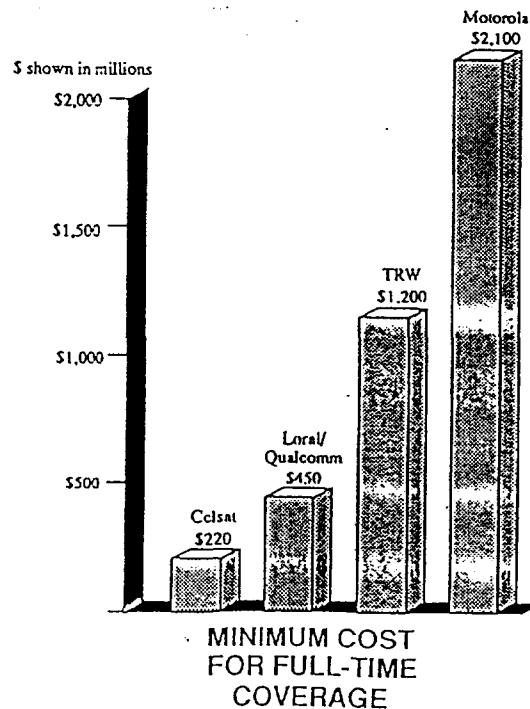


FIGURE 4

²⁵ This estimate was inadvertently misstated in CELSAT's Petition at page 18 as "one cent/VG channel/year".

2. An HPCN Offers Competition and Maximum Functionality Over One, Common Wireless System

The Commission has recently authorized several individual separate satellite and/or terrestrial-based single-purpose wireless systems, and has many others still under consideration.²⁶ In addition, of course, there are conventional cellular, BETRS, SMDR, and traditional mobile radio and paging systems which have been around for some time. An HPCN will offer healthy competition to a very broad range of existing and planned wireless services, and will be relatively inexpensive compared to most of them. Nevertheless, for many users and applications, existing services and many planned new ones will continue to have a role in the marketplace for wireless technologies.

On the other hand, HPCN is not a single-purpose service, but a sophisticated personal information communicator/navigator system for the near and intermediate future -- that is, into the early 21st century. For slightly more in terminal device costs²⁷ an HPCN terminal or service user will not only receive a lot more

²⁶ These include, for example, nationwide paging (SkyTel), air-to-ground systems (Airfone); vehicle locator (Fleetcall); RDSS (Geostar); and emergency data communications (VITA). Also, others are pending before the FCC including, in addition to the several applicants for mixed-use mobile satellite services, applications by MTel, Suite 12 Group, Video/Phone Systems, and others for combined voice / data / video service.

²⁷ HPCN is designed especially for personal information communications of a higher level than ordinary voice grade transactions. As such, HPCN transceivers will become an integral component of more sophisticated personal voice/data/video devices such as notebook and palm-sized computers, personal/mobile navigators, and other devices which are likely to be relatively high priced even without the HPCN interface. Thus, the incremental cost of adding HPCN compatibility to otherwise multifunction products will be relatively modest.

function for his/her investment, but many basic services (e.g., ubiquitous voice) will be available at lower usage charges than other existing or planned alternatives.

As to its versatile functionality, an HPCN will offer the ability selectively to call up any desired bit rate -- so-called "bandwidth-on-demand". HPCN will offer relatively low speed data for ordinary position determination information (i.e., within 300 yards), paging and associated messaging and mass calling services, synchronous and asynchronous data, and high speed data rates up to 144 kbps suitable for full- or half-duplexed compressed video, multimedia and ISDN-based applications. Alternatively, the whole bandwidth of the mobile downlink allocation (e.g., 19 MHz at S-Band) can be used for special, premium precision position determination (i.e., within 100 yards), provided the user has a compatible terminal. Thus, if position determination, total ubiquity and seamless mobility, continuity of data communications, and/or point-to-multipoint (broadcast data) transactions are important to the application, then HPCN is the superior if not the only capable alternative.

HPCN's nationwide operations, combined with its one personal number user identifier,²⁸ allow the user to both be located (position determination) and contacted (called) using one service

²⁸ While it will be possible simply to assign subscribers a conventional ten digit number from number blocks obtained through the local exchange carrier or even Bell Core, considering the potentially large number of individual subscribers likely to be involved with the service a special HPCN numbering plan would be desirable. Considering that the North American Numbering Plan is scheduled to be revised in the mid-nineties, it would be expected that HPCN interests will participate in that effort to ensure the availability of a suitable numbering scheme.

and one device. The HPCN terminal's "keep alive" and automatic position determination signals will be monitored constantly by the network controller such that its data base will always know where the subscriber can be reached. With HPCN, one device and one service would serve the equivalent functions achieved today using a nationwide pager in combination with cellular telephone at less cost, and certainly with greater convenience. (See EXHIBIT 2.)

The position determination feature, which is inherent and automatic to the HPCN system configuration and will be offered at almost no incremental cost to the user, will also facilitate special billing arrangements, fraud detection and user verification and, of course, will become an invaluable aid to police, fire, health and other public safety groups for personnel or vehicle location and other obvious emergency uses.

HPCN will prove important to meeting emerging needs, particularly for high speed data, compressed video and multimedia applications. HPCN is wedded to CDMA with FEC coding; and while this is still new as a commercial technology, the results of CELSAT's analysis as confirmed by recent field trials in San Diego have been both very exciting and convincing.²⁹ CDMA offers many inherent advantages especially suited to wireless digital data transmissions at bit rates much higher than other multiplexing schemes in a mobile environment. CDMA's "soft handoff", coupled

²⁹ See, "Next generation Cellular -- Results of the Field Trials", December 4-5, 1991, presented by the Cellular Telecommunications Industry Association.

with HPCN's simultaneous space/ground coverage of the personal/mobile user assures relative continuity of communications from cell-to-cell or, in the event of ground signal interference, within a cell. This, in turn, allows HPCN to offer both synchronous and asynchronous data, and full- and half-duplex video communications with a very high degree of reliability. Moreover, HPCN reliability is heightened when it is considered that the target HPCN market will include a high proportion of high speed data applications which will rely predominantly on portable transceivers (notebooks, laptops, and similarly portable video devices) which will be less likely to be transitting between or out of the range of cells (in contrast to more mobile vehicular-based voice and fax units).

Clearly contributing most to the feasibility of high speed data under HPCN is, again, the enormous network capacity. High speed data users consume available power (and, thus, capacity) in proportion to the data rate used. (Data transmissions at 64 kbps, for example, will consume about 13 times the power required for an ordinary voice call.) Because of HPCN's enormous capacity, it can afford to accommodate high speed data transactions without degrading the level of service available for other, more conventional uses and with no economic penalty to the data user. CELSAT has proposed in its application to offer data speeds up to 144 kbps so as to be compatible with the basic ISDN interface (BRI). While still higher speeds are attainable, in CELSAT's

judgment 144 kbps might be an acceptable place at which to draw the line without compromising grade of service.³⁰

3. HPCN Will Make Low Cost Personal, Business and Public Sector Communications Available to The Greatest Variety of Markets and Applications

The utility and improved communications made possible by conventional cellular telephone service is undisputed, while for many applications or market segments it is becoming essential. One of these is the public sector. Local, state and even federal agencies have come to rely more and more on the convenience, accessibility and relatively high performance of conventional cellular telephone services. But government budgets cannot afford the high cost of conventional cellular service and therefore the public sector is not realizing as much benefit as wireless technology has to offer. HPCN will provide even more functionality (and privacy) at the same or less costs than other commercial wireless alternatives. And, due to the competition and capacity which HPCN will introduce into the market, that cost will be lower and thus more affordable to the public sector in the near future than it is today.

³⁰ Hitachi, Ltd. recently announced a desktop (not wireless) video conference unit for use with ISDN 64 kbps service. "Hitachi Unveils Cheaper Video Conference Unit", *Wall Street Journal*, January 31, 1992, at B3. Also, AT&T recently announced introduction of a video telephone operated at 19.2 kbps. "AT&T Plans To Unveil a Videophone For the Home", *Wall Street journal*, January 3, 1992, at E3. Also, Apple Computer announced that in 1993 it will introduce pocket-sized electronic information devices using communications links, "Apple Plans to Launch Product Lines Aimed at Consumer Electronics Markets", *Wall Street journal*, January 10, 1992, at B8. HPCN will be compatible with each of these products via its interface with the PSTN.

Between space-cell and ground-cell coverage, there will be no gaps, no blind spots, and no unserved territories. With HPCN and one single-mode terminal for both space-cell and ground-cell connections the subscriber will be able to make or receive a communication anywhere -- on the ground, in the air, or at sea. Thus, it should be apparent that the strengths of an HPCN lie not only in its potential ability to supplement many current services more efficiently and at lower cost to the end user, but as a platform for launching new services to meet both more demanding and emerging applications, and new and currently unserved geographic and public service markets.

C. HPCN Will Best Serve Other Important Aspects of the Public Interest

HPCN will be welcomed as a timely, reliable and readily available service. HPCN should be reasonably accessible to users everywhere. It will serve as a superior means of emergency communications in case of natural disasters spanning very large areas or regions, while just as capable of being tailored to meet proprietary communication needs of very small "microcell" communities.

1. HPCN's Capacity and Geographic Coverage Is Expandable, Flexible, and Quickly Deployable

As already pointed out, HPCN will serve more potential end users simply because it offers more available capacity -- nearly the capacity of another MCI landline network. But not to be overlooked is HPCN's geographic breadth and the thoroughness of its

coverage. A well designed HPCN will ensure total coverage over the continental United States, Puerto Rico, the Virgin Islands, Hawaii and most of the populated areas of Alaska, and the entire rural and remote parts of the country where other systems do not reach. HPCN leaves no "gaps" in either space or time coverage over the United States. Thus, HPCN will serve the largest possible number of customers because it simply will reach more people with the capacity to serve them at a low price. These considerations, coupled with the its greater functionality, reasonably assure HPCN of a potential subscriber base of between 10 and 30 million users.

Another HPCN advantage is that the system can be deployed quickly. It does not have to be built out to maximum capacity all at once, and therefore will reach the market in the shortest time following Commission authorization. HPCN can be developed in stages, as its customer base grows, and as funding becomes available. In fact, any such system would start out with just one satellite, with the other deployed later. A one satellite configuration will still provide total ubiquitous coverage over CONUS with the same number of space-cells (but with only about three fifths the communications capacity). Position determination would be limited or unavailable until the second satellite was in orbit.³¹

³¹ Position determination will use combinations of either space-to-space, space-to-ground-cell, and ground-cell-to-ground-cell position information. Thus, with only one satellite deployed full, automatic position determination would be available only to subscribers calling from within an active ground-cell service area. Also, full, automatic space-based position determination under CELSAT's design will not be available in Puerto Rico/Virgin Islands, Hawaii and most of Alaska which will only be visible to one satellite even after both are deployed. The eastern satellite will cover CONUS, Puerto

2. HPCN Will Integrate/Focus Communications Throughout Local, Regional And Nationwide Communities of Interest

An HPCN network can be flexibly configured -- focused or dispersed. CELSAT, for example, would group HPCN space-cells into regional market service areas (i.e., "clusters") on either a contiguous or non-contiguous basis. Most clusters would include up to ten space-cells, logically and contiguously situated around each major U.S. regional population center or economic market. The cluster would be served by a single backhaul link and gateway.³²

Communications within these relatively large regions (each likely to be about the size of a Regional Bell Operating Company territory) would be treated like a super-sized "local calling area", thereby allowing for low cost, toll free-like calling throughout the whole regional "community". Each space-cell belonging to the cluster (and all ground-cells within such space-cells common to that cluster) would share access to a common network controller, common database, common switched access to the PSTN, and common SS#7-type signaling and network intelligence for added service functionality and efficient, secure operations.

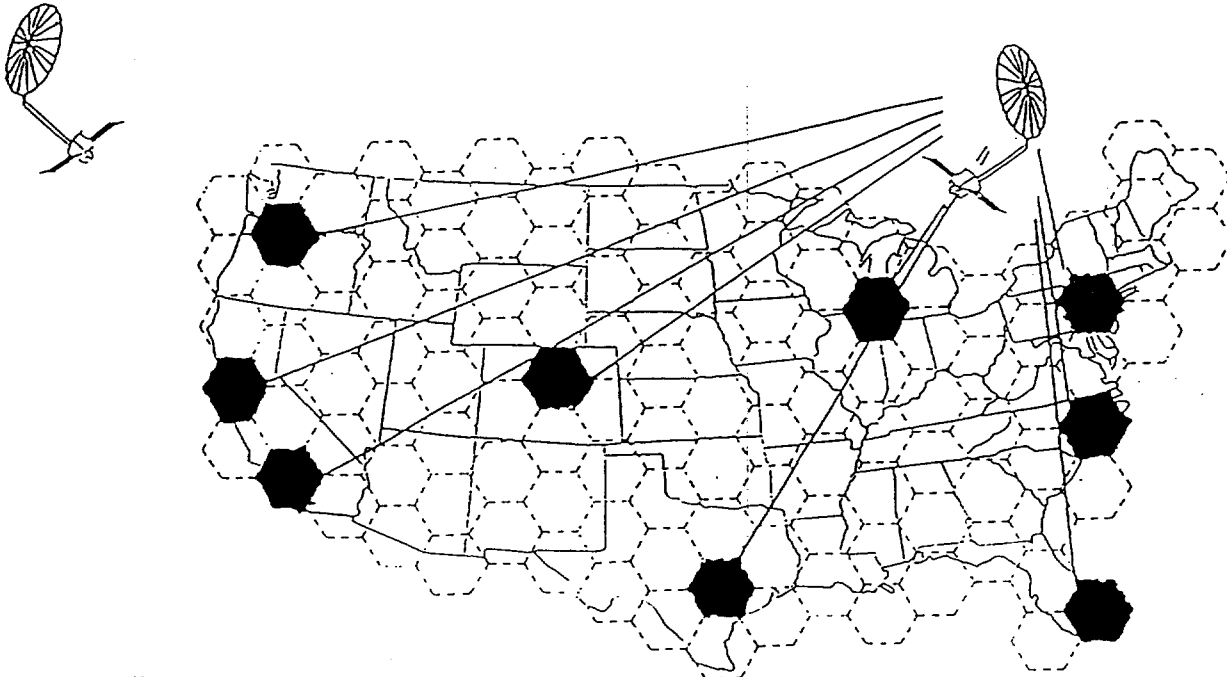
With the exception of Guam and other Pacific Rim U.S. territories and possessions, no U.S. geographic market would be isolated or difficult to reach. Non-contiguous locations such as

Rico/Virgin islands; the western satellite will cover CONUS, Alaska and Hawaii.

³² For a technical discussion of the "clustering" concept see Appendix "Overview of CELSTAR System", Appendix A hereto, and CELSAT's pending application. Other HPCN configurations are, of course, possible.

Hawaii, Alaska and the Virgin Islands logically should be tied to CONUS as members of the "clusters" with which they have the greatest common interest (i.e., Hawaii with California; Alaska with the Northwest; and P.R./V.I. with the Southeast). Thus, low cost communications to or from the mainland would be possible using the space-based channels, with no backhaul cost penalty for ordinary local communications within those remote markets.³³

As yet another alternative, at least one "cluster" could be made up of non-contiguous space-cells serving key U.S. population centers or economic market areas. This would form a "metropolitan bus" for direct communications by space-cell channels on an end-to-end basis. The metropolitan bus (FIGURE 5) would



Illustrative HPCN Metropolitan Bus

FIGURE 5

³³ It is possible to have multiple earth stations or hubs serving the same HPCN cluster. It would be logical to service the space-cells associated with Alaska, Hawaii and P.R./V.I. from both a CONUS-based hub, and a redundant, local hub to avoid backhauling traffic.

Further indicative of HPCN's flexibility, ground-cell size in terms of coverage area can be very selectively controlled. For example, ground-cells could be very small (i.e., PCN-like microcells), or scaled to overlay many existing mobile cellular coverage areas (i.e., about 6 kilometers radius). CELSAT envisions considerable overlap with existing cellular systems in the major market areas. But HPCN microcell configurations could also be deployed to satisfy the particular needs of a special market or end-user application where neither conventional cellular nor emerging PCN would be technically or economically feasible. For example, industrial, commercial or university campuses, in either urban or rural locations, and military bases located at very large rural tactical training sites reasonably could support proprietary HPCN microcells. Whether a separate subband would be allocated to meet such need, or the site would be served using other subbands apportioned for public use within the common space-cell area would be considered on a case-by-case basis. Such proprietary microcell systems and their terminal devices, however, would still have to be technically compatible with and under the control of the overall HPCN space/ground system operator.³⁴

3. HPCN's Redundancy and Utility As An Emergency Communications System Is Superior

A hybrid personal communications network of CELSAT's design has superior standby and inherent backup features unlike any alternative other than the local exchange network itself. These qualities serve both to enhance its own reliability, as well as position HPCN as the fall back network of choice in the event of local or regional natural disaster.

³⁴ This could be a benefit in that the proprietary microcell user community could, on the one hand, block non-member traffic, while still using their HPCN terminals for general purpose access to the "public" HPCN system.

As to the former, it has been discussed above how both space and ground-cell systems can operate on one satellite in the event the other satellite should fail. Total ubiquitous coverage over CONUS would remain, although there would be a reduction in service capacity. Similarly, the HPCN space-cells would still carry traffic in the unlikely event any portion or even all of the ground systems failed. In fact, space-cell capacity could be increased slightly in the affected space-cell areas by re-deploying the ground-cell subbands for satellite use.

Thus, not only is the HPCN's own reliability assured, but its value and ability to meet the demands of almost any conceivable local or regional disaster as a versatile, high capacity emergency backup communications system is unmatched.

IV. CELSTAR'S INNOVATIVE USE OF TECHNOLOGY WILL CONTRIBUTE TO EXTREME SPECTRAL EFFICIENCY

CELSAT has identified at least two band pairs of modest spectrum bandwidth, each well suited to the operation of a separate *hybrid personal communications network*, and also well within the technical reach of today's mobile satellite and personal transceiver power and other relevant operating capabilities.³⁵ CELSTAR will operate with comparable efficiency in either of these proposed bands. Moreover, when used for HPCN purposes as proposed, certain interference problems and capacity constraints

³⁵ See, Petition at page 32, and Appendix B thereto.

characteristic of other alternative mobile satellite proposals either go away or are mitigated.

A. HPCN Is The Most Spectrally
Efficient Wireless System By Far

CELSTAR's frequency efficiency factor in the satellite-only mode is at least five (5.3) times better than that of the next most efficient space system proposal; while, with simultaneous ground utilization included, frequency efficiency increases by two orders of magnitude over any other method described. Each space cell in each cluster reuses all (i.e., 100%) of the available spectrum with no spatial cell separation required (i.e., CELSTAR's S-Band reuse factor over the United States = 112 [149 for L/S-Band]).³⁶ TABLE I, *supra*, illustrates the far superior frequency conservation characteristics of an HPCN system such as CELSTAR.³⁷

A complete frequency plan for CELSAT's HPCN system is summarized in TABLE 2 below.

³⁶ CELSAT wishes to emphasize that the reuse levels attained using HPCN apply proportionally with the area to be served. Thus, its reuse factor would be proportionally larger and thus even more astonishing if its potential capacity to areas outside the U.S. were also considered.

³⁷ Another measure of spectral efficiency is indicated by the capacity of the system to transmit data in bits/Hz. When measured on this basis CELSTAR achieves a spectral efficiency of about 9.5 bits/Hz. (Assuming CELSTAR L/S-Band operation using 32 MHz, and 60,900 space-based simultaneous channels of 5000 kbps each.) Compare this to the spectral efficiency of between 0.36 and 0.48 bits/Hz offered by another pending proposal for a wireless nationwide data network capability. See, *In the Matter of Mobile Telecommunications Technologies Corporation Request for a Pioneer's Preference Regarding its Petition for Rulemaking to Allocate 150 kHz in the 930-931 MHz Band to Establish Rules and Policies for a New Nationwide Wireless Network (NWN) Service*, November 12, 1991, at pages 11-12. Of course, if CELSTAR's ground-cell reuse potential was included in the measure, its spectral efficiency would be increased 10 fold -- to over 100 bits/Hz.

FREQUENCY PLAN
01/18/92 14:05
UHF MOBILE LINKS

FUNCTION	ALTERNATE A				ALTERNATE B			
	FORWARD (DOWN)		REVERSE (UP)		FORWARD (DOWN)		REVERSE (UP)	
	WIDTH MHz	FREQ MHz	WIDTH MHz	FREQ MHz	WIDTH MHz	FREQ MHz	WIDTH MHz	REV. MHz
LOWER BAND EDGE		2110		2410		2483.5		1610
PILOT	1.25				1.25			
LOG-IN			0.25				0.25	
CALL SERVICE	0.25		0.25		0.25		0.25	
TRAFFIC	17.5		17.5		15		15	
TOT. TOTAL BW	19		18		16.5		15.5	
UPPER BAND EDGE		2129		2428		2500		1625.5

BACKHAUL LINKS 10 CELLS/CLUSTER

FUNCTION	PRIM ALTERNATE A				ALTE ALTERNATE B			
	FORWARD (UP)		REVERSE (DOWN)		FORWARD (UP)		REVERSE (DOWN)	
	WIDTH MHz	FREQ MHz	WIDTH MHz	FREQ MHz	WIDTH MHz	FREQ MHz	WIDTH MHz	REV. MHz
LOWER BAND EDGE		29800		20000		29800		20000
TRAFFIC	190		180		165		155	
TT&C	5		5		5		5	
TOTAL BW	195		185		170		160	
UPPER BAND EDGE		29995		20185		29970		20160

CELSAT Frequency Plan

TABLE 2

B. HPCN Minimizes Many Frequency And PFD-related Problems

CELSAT has also addressed the issues of potential interference to other spectrum users in both proposed Bands A and B, and is pleased to be able to report that it appears that its HPCN design either does not create the interference concerns raised by the proposals of other applicants (particularly in the requested L/S-Bands), or, where an interference problem might otherwise exist, HPCN's innovative flexibility offers solutions for avoiding the problem not available under any other system proposal. (See Petition, Appendices C and D.) For example, CELSAT's large number

of individually controllable transponders and corresponding number of relatively small-sized ground footprints permits very selective power control on a space-cell-by-space-cell basis.³⁸ This allows much closer conformance to international frequency and power limitations along the Canadian and Mexican borders than any other proposed system. HPCN also offers the ability selectively to control frequency subbands and power levels in areas susceptible to interference with other users of the spectrum, such as for radio astronomy purposes. HPCN's control over power to non-interfering levels is not only geographic, but also time-of-day variable, thereby allowing the HPCN to cut power in vicinity of other users of the spectrum during coordinated periods of actual use, and resume power in order to restore full capacity at all other times. Further, CELSTAR can avoid conflict with GLONAS users.

Thus, CELSAT's HPCN offers the Commission a technical solution to difficult spectrum interference problems unavailable in the context of any other system proposal.

**V. CELSAT'S HPCN WILL ALLOW THE COMMISSION
TO MAXIMIZE USE OF THE SPECTRUM, WHILE ASSURING
SERVICE FLEXIBILITY, COMPETITION AND BUSINESS OPPORTUNITY**

The *hybrid personal communications network* concept described here and in CELSAT's Petition is larger and more comprehensive than any single radio-based personal communications

³⁸ The space-cell locations along the U.S. borders as shown at Figure 1, *supra*, are illustrative only. Their actual position and effects on international frequency compliance relative to the U.S. border will be adjustable and controllable.

system or service proposal ever before considered by the Commission. In terms of potential subscribers, CELSAT's HPCN is potentially as large or larger than the existing analog wireline and non-wireline cellular industry systems combined, plus all the proposed MSS/RDSS satellite systems, all operated together as one huge domestic space/ground radio communications network. As such, its capacity and potential not only to serve subscribers but also to revitalize American industry and leadership in the production and supply of wireless devices and supporting network infrastructure subsystems and space components is equally enormous.

There is an important anatomical difference between HPCN and the existing/emerging wireless industry structure. Whereas the latter is molecular, with numerous ground cellular systems and the proposed satellite MSS/RDSS systems operating under different technologies and owned by many separate competing entities, the HPCN concept is atomic-like. Around each *hybrid* geostationary satellite system there will evolve from one to hundreds of small, functioning ground-cells, each tied to the satellite nucleus under the influence of its system network controller.

In most respects, multiple entry and separate allocations of geographic territories under the Commission's contemporary allocation policies have worked well in that clearly we have the world's finest cellular service, the first nationwide satellite paging and air-to-ground in-flight passenger services, and soon, using one system or another, we will have MSS/RDSS satellite services. On the other hand, the prevailing wireless industry

dichotomy is not without its drawbacks including, for example, the high cost of air time; insufficient mobile system capacity due to uncoordinated spectrum sharing; gaps in service coverage; problems with billing; difficulties in locating roamers from one system to another, etc. Additional problems can be expected including the probable incompatibility among next generation digital cellular technologies,³⁹ and similar incompatibility between emerging space and existing ground-based systems.⁴⁰

Nationwide HPCNs present an opportunity to avoid incompatibility and related problems from the outset, but it requires a different business/industry structure. Fully functional, maximum capacity HPCNs must be constructed and operated as single, nationwide systems, each under the control of one licensee. As CELSAT discusses in its Petition, this is primarily for technical rather than purely economic reasons.⁴¹ But, as CELSAT

³⁹ The cellular industry through its national trade association, CTIA, has recently approved a TDMA standard suitable for next generation technology, and many cellular systems have committed to this format, including systems in Los Angeles, Chicago and Dallas. *Id.*, n. 13. CDMA, on the other hand, is also likely to be approved as an alternative technology, as could NAMPS. The unfortunate end result may well be a patchwork of partially or even totally incompatible operating systems, effectively either reducing the utility of future cellular telephones to localized or regionalized service, or requiring high cost, dual mode handsets. While the heavy consolidation going on within the cellular industry will serve to mitigate the potential effects of diverse and incompatible cellular technology, the fact of such consolidation is, itself, another argument in favor of authorizing a single, nationwide HPCN.

⁴⁰ These problems have been somewhat eliminated in other parts of the world, for example, where countries like Germany and Great Britain have granted national licenses for cellular and/or PCS networks. National licenses, whether for digital or analog systems, allow the licensee to design and construct a fully integrated network to compete with other service providers. Regulatory bodies ensure that the licensee will meet network build-out and operating guidelines by mandating coverage milestones, much like local U.S. communities do for cable television.

⁴¹ CELSAT's proposal of nationwide HPCN network licenses is not grounded on economic justifications alone. Deployment cost and economies of scale are not the principal reasons for the nationwide licensee approach. HPCN, as proposed by CELSAT, is a low cost satellite system (for

has also proposed, such a nationwide license structure is possible without compromising the Commission's proven pro-competitive objectives. Accordingly, CELSAT submits that even under a nationwide licensee structure, its HPCN concept will be extremely conducive to:

- Competition with existing cellular and other proposed satellite and PCN systems;
- Early and lowest cost deployment of a nationwide personal/mobile system;
- Flexibility to create and offer the greatest array of new services;
- Low cost service to the maximum number of subscribers;
- Maximum new business and employment opportunities, particularly among device and infrastructure suppliers;
- And greatest frequency efficiency.

A. CELSAT Should Be Awarded A Preference To
Operate CELSTAR As One Nationwide HPCN System

CELSAT is mindful of the Commission's strong preference for a multiple entry competitive market structure. As much as possible but without sacrificing any of the important distinguishing attributes of the HPCN approach (i.e., frequency efficiency, space/ground capacity, and cost effectiveness), CELSAT intends to propose in its application a means whereby some sharing of the requested spectrum will be realized, even though the Commission is being asked to authorize only one *hybrid personal communications network licensee per spectrum pair allocation*. But irrespective of whether CELSAT's spectrum sharing proposal is

example, several HPCN systems could be deployed a less cost than an IRIDIUM system). As pointed out in the text to follow, CELSAT's approach is dictated more by technical constraints, operating limitations, and a national policy favoring the best possible use of the scarce spectrum resource.

adopted, in order to ensure maximally coordinated reuse of the spectrum, it is technically essential that there be only one such nationwide system operating in a spectral band pair.⁴²

As discussed above, one of the most powerful features of the HPCN concept is the ability to dynamically allocate resources, including spectrum, between the various service demands of different time and place. In particular, this includes the internal use of the spectrum subbands for either ground-cell or satellite-based personal/mobile service as the demands of the time, circumstances and place dictate. In order to realize this important flexibility it is technically essential that the HPCN band allocations be primary and exclusive, and each under the active supervision of a *single point of control*.⁴³ CELSAT believes that this can only occur if HPCN allocations are each under the control of a single licensee.⁴⁴

In addition to the firm technical reasons, there are capacity and economic considerations why a single licensee is desirable. Even if it were technically feasible to share such an

⁴² This is not to state that other HPCN systems might not be considered at other band pair allocations.

⁴³ For a further technical discussion on the need for single, nationwide control, see Petition at pages 41-45.

⁴⁴ Any requirement to share an HPCN band on the basis of a proportional allocation of either the spectrum or power flux density necessarily results in a corresponding reduction in the potential capacity of each sharing system such that the sum of the individual capacities would be less than the "whole". Even if each co-sharer of the allocated spectrum agreed to build and construct identical HPCN satellite systems with a combined theoretical ability to attain the same maximum space-cell capacity notwithstanding power sharing, the resulting multiplicity of system satellites, hubs, network controllers, etc., would be tremendously wasteful and nowhere near as cost effective as one single system efficiently using all of the available spectrum band.

allocatable resource, to do so would seriously degrade its effectiveness, as no single sharer could be assured of enough total capacity to permit relatively quick or even long term commitments to emergency ground-cell use without possibly unacceptable impact on its primary satellite grade of service.⁴⁵

For these reasons, CELSAT submits that the Commission should award it a Pioneer's Preference for exclusive authority to construct and operate a *nationwide hybrid personal communications network* within one of the requested HPCN spectrum allocation pairs. Other applicants for similar nationwide exclusivity should be considered, but only in a separate band pair allocation.

B. CELSAT's HPCN System Application
Will Offer "Pseudo" Spectrum Sharing

As pointed out above, a true and full *hybrid personal communications network* as proposed by CELSAT must be under the control of and operated by one licensee. It is simply technically and practically necessary to operate it that way. However, this is not to say that the huge capacity of any one HPCN *space segment* cannot be licensed and operated differently from the combined HPCN ground/space system, and CELSAT is confident that it can be. To

⁴⁵ This further assumes that dynamic apportionment of subbands would be practiced in a shared, multivendor environment. In practice, it would not work.

this end CELSAT's application intends to offer a form of "pseudo spectrum sharing", as described below.⁴⁶

As background to this proposal, CELSAT would refer to the current requirement of Section 25.141(e) of the Commission's rules which effectively mandates spectrum sharing of the L/S-Band by multiple RDSS licensees on the basis of coding and power limiting techniques.

Under the present L/S-Band RDSS-type of spectrum sharing multiple entry by the several pending applicants, all forced to operate at reduced power and thus at less than full capacity, is certain only to increase the effective cost per circuit for each system, increase the ultimate price to the end user, and possibly jeopardize the viability of one or more of the competing applicants. In effect, the Commission would struggle with trading a reduction in the maximum total capacity theoretically available using the allocated bandwidth in favor of licensing two, three or even four different licensee/providers -- all at high cost, and no one of which would have enough capacity to offer a sufficiently low cost, high volume service to meet the emerging needs of the latter half of this decade, let alone of the early twenty-first century.

If awarded a preference and a license to construct an HPCN as proposed, CELSAT intends to offer rights to transponder

⁴⁶ Such pseudo sharing should not be required. CELSAT is proposing that the Commission merely permit such sharing, and leave it the individual HPCN applicant(s) to propose whether and, if so, how much spectrum capacity each would be willing to offer under such an option. CELSAT is filing an application for HPCN authority and request for Pioneers Preference in which it is proposing to offer up to 18% of its space capacity under a pseudo sharing arrangement.

capacity on its HPCN satellites on an Indefeasible Right-of-Use or IRU-like basis to other qualified providers.⁴⁷ The IRU-holders would, of course, receive the same nationwide coverage and the benefits of all the functionalities inherent to the HPCN system, plus any additional ones they might choose to design into it and offer (provided that they remain technically compatible).⁴⁸ In other words, there should be one satellite system constructed and operated in the new HPCN band, but once launched, a predetermined amount of digital capacity on that system could be permanently and unconditionally surrendered to the IRU purchaser(s) for whatever compatible services they choose and are licensed to offer.

⁴⁷ An Indefeasible Right of Use, or IRU is an established industry convention for defining structured joint relationships in common facilities by multiple parties. It is used particularly in the context of international cable or satellite communications facilities. Historically, an IRU interest usually related to a specific or even discretely identifiable portion of the facility, such as a designated transponder on the satellite. However, it can also refer to a specific unit of capacity, appropriate to the medium or facility involved including undersea fiber cable. For purposes of CELSAT's proposal, "IRU-like" is intended to refer to the transfer of all rights of use to a discrete amount of usable satellite system capacity, to be expressed in units most relevant to the digital nature of the system technology.

For purposes of simplifying the discussion of the concept, the petition expresses IRU capacity in terms of equivalent VG circuits (e.g., 18% of 60,900 total circuits or about 10,000 VG IRU circuits.) Ultimately, however, and in the interest of assuring that the IRU-holder has maximum flexibility to use the available capacity and digital bandwidth to its fullest capacity, the IRU-like allotment might be more appropriately expressed in other suitable and measurable units, such as a portion of the total available power capacity.

⁴⁸ For many of the same reasons dictating that there must be only one HPCN licensee, CELSAT cannot suggest that corresponding capacity on the ground-segment system be offered on an IRU-like basis. The reasons are primarily technical and also have to do with the more limited individual capacity of each ground cell vis-a-vis the comparatively larger capacity of the space-cells and space-segment as a whole.

However, inasmuch as spread spectrum CDMA compatibility and power control will be inherent and common to the personal/mobile terminals of both the HPCN and the IRU-holder subscribers, the latter users will enjoy full access to the ground segment services offered over the HPCN, and vice-versa. Thus, details of potential overlapping service use by the different groups of customers will simply have to be worked out through common billing/revenue sharing agreements, etc.

Under CELSAT's IRU-like scheme, the other "participants" will not be constrained artificially to offer the same services, or serve the same geographic or end-user markets as the master HPCN licensee offers. An IRU-holder might choose, for example, to sell exclusively to the public safety market sector, or specialize in only compressed video applications. With certain necessary technical and operations-based exceptions to be established by the HPCN licensee, licensed IRU-holders would neither be constrained by nor accountable to the HPCN licensee, but would have relatively free and unfettered use of the IRU capacity that they purchased.

VI. CONCLUSION

The Commission's *Pioneer's Preference Order* provides guidelines and standards for establishing eligibility for a PP license. The Commission has indicated that it would only grant such a preference to applicants that have invested significant efforts to develop either innovative technology or new or enhanced services:

The Commission, in its discretion, will award a pioneer's preference to an entity that demonstrates that it . . . has developed an innovative proposal that leads to the establishment of a service not currently provided or a substantial enhancement of an existing service

* * * * *

[W]e will consider the development of an innovative proposal to mean that the petitioner . . . has brought out the capabilities or possibilities of the technology or service or has brought them to a more advanced or effective state. Generally we believe that an innovation could be an added functionality, a different use of the spectrum than previously available, or a change in the operating or technical characteristics of a service, any of which involve a substantial change from that which existed prior to the time the preference is requested. Further, technologies that yield efficiencies in spectrum use, speed or quality of information